§1. Matching Optics Unit for 82.6GHz Gyrotron

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In the third cycle LHD experimental campaign, the arcing limited the power level transferable to LHD. One of the most plausible candidates for the arcing is the excitation of the undesired mode in the waveguide transmission system. In order to excite as high purity HE_{11} mode as possible, the matching optics unit (MOU) mirrors are optimized with the given mirror configuration and with the measured real output beam from each gyrotron. Even with the same design, gyrotron has its own characteristic output beam. The MOU mirrors should be calculated and fabricated for each beam characteristics and mirror configurations.

In Fig.1 are shown the gyrotron, new mirrors and waveguide configurations. The output beam from the gyrotron is measured at several point by recording the mode pattern on the target paper screen set at several distances from the gyrotron window. The beam is reconstructed for the phase retrieval[1]. The reconstructed beam is used for the base of the optimization of the MOU mirrors. Fig. 2 is surface contour plot of the a) first and b) second MOU mirrors.

The water calorimetric load is build in at the outside of the shield box which surrounds the hole mirror systems in Fig. 1. The switching flat mirror is installed in between the flat mirror and focusing mirror. This switching mirror can be shifted off by a pneumatic slide mechanism to transmit the beam to the waveguide. Similar but another switching mirror is installed between the turning mirror and water calorimetric load to guide the beam to the brick dummy load. The brick dummy load is used for the long pulse, high power conditioning and the water calorimetric load is used to calibrate the gyrotron output power up to 500 ms pulse.

The beam alignment is performed by the fine adjustment mechanisms of the holder of each mirror comparing the burn pattern with the calculated one on each mirror. The beam center is adjusted to coincide with the spot of the He Ne laser beam on the axis of the waveguide on the final mirror. The all adjustment mechanisms of mirrors are designed so that the mirror center becomes a fixed point during the adjustment.

The transmission power and pulse width is increased gradually during the fourth cycle experimental campaign. Although the arcing occurred during the initial phase of the commissioning, the transmission power finally reached near 400 kW and pulse width up to 0.8 sec at the MOU without arcing. As compared with the achievement of third cycle experimental campaign, it can be concluded that the effect of the mode optimization is large. The same configuration will be used for the fifth cycle experimental campaign.

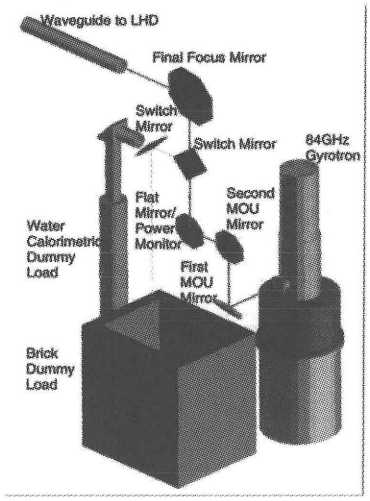

Figure 1: The matching mirror configuration of the 82.6GHz gyrotron. First and second mirrors are the designed so as to make the coupling to the HE_{11} optimum. The calculation is based on the beam output measurement using the IR camera and the given mirror configuration.

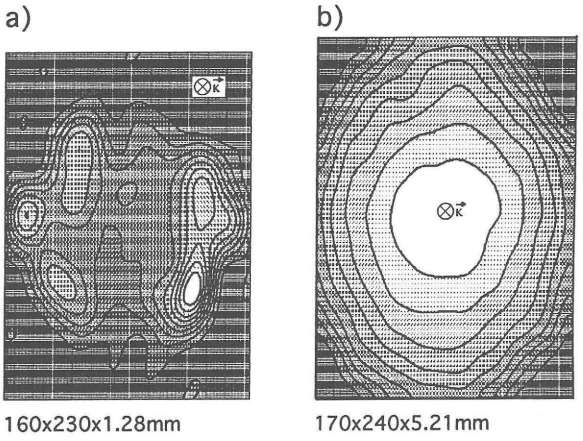

Figure 2: The contour plot for the a) first and b) second mirrors. The mirror calculations are based on the reconstructed output beam from the gyrotron and the configurations of mirrors and waveguide in Fig. 1.

References
1) A. V. Chirkov,G. G. Denisov, N. L. Aleksandrov, Opt. Commun., **115** 1995, 449.